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on the

New Brunswick Software Industry

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS iv

LIST OF FIGURES v

TASK GROUP MEMBERS vi

1.0 EXECUTIVE SUMMARY 1

2.0 INTRODUCTION 5

3.0 MANDATE OF THE TASK GROUP 7

4.0 THE CANADIAN SOFTWARE INDUSTRY IN THE GLOBAL CONTEXT 8

5.0 PROFILE OF THE NEW BRUNSWICK SOFTWARE INDUSTRY 13

6.0 PROBLEMS FACING THE NEW BRUNSWICK SOFTWARE INDUSTRY 20

6.1 Financing 20
6.1.1 The Problem 20
6.1.2 Possible Solutions 23
6.1.3 Conclusion 24
6.2 Access to Technology and Training 25
6.2.1 The Problem 25
6.2.2 Possible Solutions 26
6.3 Local Market Acceptance and the Image of the Industry 27
6.3.1 The Problem 27
6.3.2 Possible Solutions 28
6.4 Human Resources 29
6.4.1 The Problem 29
6.4.2 Possible Solutions 31
6.5 Government Procurement Policies 32
6.5.1 The Problem 32
6.5.1.1 Overview 32
6.5.1.2 Product Development Opportunities 33
6.5.1.3 In-House Development 34
6.5.1.4 Out-of-Province Purchases 34
6.5.2 Possible Solutions 35
6.5.3 Conclusion 36
6.6 Marketing New Brunswick Software 37
6.6.1 The Problem 37
6.6.2 Possible Solutions 38

6.7 Liaison between Industry, Universities, and Governments 39
6.7.1 The Problem 39
6.7.2 Possible Solutions 39
6.8 Funding of Current Hardware and Software at the University Level 41
6.8.1 The Problem 41
6.8.2 Possible Solutions 42

7.0 FACTORS FAVOURING THE NEW BRUNSWICK SOFTWARE INDUSTRY 43
7.1 Business Support 43
7.2 The Post-Secondary Education System 45
7.2.1 Degrees Related to Computer Science and Marketing 45
7.2.1.1 Computer Science Programs 45
7.2.1.2 Marketing Programs 46

8.0 STRATEGIC TECHNOLOGIES OF IMPORTANCE TO NEW BRUNSWICK 48
8.1 Target Computing Environments 48
8.2 Tools and Technologies for Software Development 50
8.2.1 Artificial Intelligence (AI) 50
8.2.2 Geographic Information Systems (GIS) 52
8.2.3 Computer Aided Software Engineering (CASE) Tools 53
8.2.4 Application Areas of Importance to New Brunswick 53
8.3 Implications for the Industry 54

9.0 PLAN OF ACTION AND RECOMMENDATIONS 55
9.1 Recommended for Immediate Implementation 55
9.1.1 Awareness Program 55
9.1.2 New Brunswick Software Industry Association 55
9.1.3 Publish and Maintain an Up-to-Date Industry Database and Directory 57
9.2 Short-Term Strategies 58
9.2.1 Develop a Program to Support R&D 58
9.2.2 Exploit Strategic Technologies 58
9.2.3 Incentives for In-Province Training 59
9.2.4 Implement Financial Incentive Packages 59
9.2.5 Establish an Offset Program 60
9.2.6 Enforce Existing Contracting-Out Policies 60
9.2.7 Promote Marketing Assistance Programs 60
9.2.8 Establish a Permanent Joint Organization 60
9.2.9 Support Computer Science Departments in Meeting Hardware and Software Requirements 61
9.2.10 Continue Business Support Programs 62

REFERENCES 63

GLOSSARY OF TERMS 64

ACKNOWLEDGEMENTS

In June 1989, a Task Group on the Software Industry was established in order to identify key technological opportunities and constraints to software development in New Brunswick, and to recommend appropriate measures to stimulate and accelerate development of this industry. Funding for Task Group expenses was provided under the Canada/New Brunswick Subsidiary Agreement on Industrial Innovation and Technology Development. Members of the Group gave freely of their time, expertise, and guidance in the compilation of this report.

We wish to acknowledge and thank the numerous contributors who assisted us in the study and to extend a special thanks to the Department of Commerce and Technology for giving us the opportunity to provide this input.

LIST OF FIGURES

FIGURE 1	Number of Firms in the Four Industry Subsectors (1986)	11
FIGURE 2	Percentages of Total Revenue ($2.5 b.) for the Four Subsectors (1986)	12
FIGURE 3	N.B. Software Companies by Employment Size (1989)	15
FIGURE 4	N.B. Software Companies by Total Revenue (1986-1987)	16
FIGURE 5	N.B. Software Industry: Industry Classification (1987)	17
FIGURE 6	N.B. Software Industry: Software Product Applications (1987)	18
FIGURE 7	N.B. Software Industry: Software Markets (1987)	19
FIGURE 8	Structure of Proposed Liaison Group	40

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1.0 EXECUTIVE SUMMARY

> *We are rapidly moving from a have and have-not world to a know and know-not one. Knowledge of new technologies is critical if we are to produce the quality products the new economic environment requires . . . Our progress in technological innovation . . . will be a strong indicator of New Brunswick's ability to compete* ("Toward 2000: An Economic Development Strategy for New Brunswick," 1989).

Computer software is proving to be an especially important technology for virtually all sectors of industry in both the province and in Canada as a whole. Because it provides access to timely information, software has become a vital factor in building a competitive advantage. As a result, the success of the New Brunswick software industry can be considered to be of strategic importance for leveraging economic growth in the province.

With this in mind, the Task Group on the New Brunswick Software Industry was formed in June 1989, with a mandate to recommend a plan of action for the further development of the province's software sector. The "software industry" is defined as consisting of those private sector firms which are engaged, either wholly or in part, in the development of computer software, knowledge-based products, and related computer services.

The software industry in New Brunswick is representative of the Canadian industry as a whole. Despite burgeoning growth in this industrial sector, represented by a dramatic 40 percent increase in the number of industry firms between 1987 and 1989, the New Brunswick software industry is struggling to achieve the necessary "critical mass" required to ensure a secure future over the next decade. American software companies, acknowledged to be world leaders, are an ever-present force to be reckoned with. Moreover, increasing competition from large, well-established Canadian firms continues to threaten the development of a vital local industry.

There are several major problems which must be overcome before the software industry in this province can become a significant player, both locally and in the international marketplace. It is expected that, as a result of this report, the provincial and federal governments will work together with local firms to resolve the issues and implement the recommendations proposed by the Task Group.

Financing is a primary concern facing the typical software company. Due to the lack of tangible assets or "visible" products that can be offered as security, it is quite difficult and in many cases virtually impossible to obtain adequate financing through conventional channels.

Another problem that must be overcome is the general dearth of knowledge within New Brunswick regarding the capabilities of the local software sector. The perception held by local firms and government agencies that New Brunswick software companies have little to offer has resulted in the lack of a positive image for the industry as a whole. This perception must be challenged and a positive image developed. To this end, the Task Group supports the formation of an "Awareness Program," designed to make governments and private industry aware not only of the short-term but, in particular, of the long-term benefits to be realized by supporting New Brunswick software companies.

At present, provincial procurement policies for computer software are also not designed to encourage growth in the local software industry. Yet this represents one vital area where the province can directly affect the development of the software sector. Much of the software used within the government is either developed in-house by Supply and Services and other departments or acquired from out-of-province sources. If more work were directly contracted out to local firms, substantial benefits would be realized in the creation of additional jobs, in the acquisition of greater expertise, and in the exportation of new products through the commercialization of the completed software.

The present volume of software development work available is a major inhibiting factor for New Brunswick firms attempting to attract and retain well-qualified human resources. The province's educational system produces many excellent Computer Science

graduates each year; but the majority of these individuals seek work elsewhere because of the lack of career opportunities within the province.

There is also fear that the decreasing level of funding for Computer Science education will leave New Brunswick graduates at a serious disadvantage technically when compared to their counterparts in other provinces. Similarly, local computer firms presently experience difficulty in accessing training programs for their existing staff. As very few of the available courses are held in the Maritime provinces, a company wishing to stay on the leading edge of technology must be prepared to incur considerable expense in acquiring training for its staff.

In order to tackle and resolve these problems, the Task Group strongly recommends that the New Brunswick government, the private sector, and the universities work together to create an environment which will promote and sustain growth in the province's software industry. Some specific recommendations include:

- Exploit opportunities in the strategic technologies (eg. artificial intelligence, GIS, and CASE tools).
- Establish a New Brunswick initiative to provide funding to the industry through a Stock Savings Plan, a provincial holding company, or other means.
- Create an offset program which would require out-of-province suppliers to purchase local software products and services.
- Reduce in-house software development by government departments in favour of contracting out projects to the private sector.
- Increase the opportunities for commercialization of government-developed software.
- Promote and maintain the marketing assistance programs that are aimed at increasing the level of marketing expertise within the industry.
- Sponsor the establishment of a strong Software Industry Association.

In the 1990s, the demand for software will increase dramatically; and there are many areas in which New Brunswick firms could excel. Some strategic technologies that are already being exploited by local companies are Artificial Intelligence (AI) applications, Geographic Information Systems (GIS), knowledge products, and Computer Aided Software Engineering (CASE) tools.

These areas, however, require considerable research and development funds; and the Task Group believes that, if the New Brunswick software industry is to compete effectively at home and abroad, the government must make every effort to encourage and support these activities.

2.0 INTRODUCTION

The 1970s witnessed the development of the microprocessor, an integrated circuit containing a complete Central Processing Unit (CPU) on a single chip. The microprocessor was a revolutionary new tool which would have a profound effect on the way modern society was to manage and derive information and knowledge. Rapid developments in computer technology followed, with each new computer offering significant improvements over previous versions. It was soon recognized, however, that no matter how sophisticated or complex, the computer hardware itself was of little value without the instructions which told it what to do: the software.

Although it is stored on a concrete computer medium -- typically a floppy disk -- software is an intangible product. Nevertheless, it is a product of increasing importance in our information- and knowledge-based society. Information is currently recognized as one of the most valuable resources of communities, corporations, and governments; and, more and more, that information is provided and accessed through the use of software. The software sector, then, is a growth industry -- in fact, the fastest growing sector of the Canadian economy -- with a great potential for expansion in the years to come. It is also a significant industry which impacts greatly not only on all industry sectors, but also on the economy as a whole.

The Task Group on the New Brunswick Software Industry was formed as a result of the provincial government's recognition of the significance of the software sector. The purpose of this report is to address issues relating to methods of exploiting the potential of this emerging industry and of ensuring its long-term vitality. The Task Group trusts, moreover, that the information and possible solutions contained in this report will provide the government with a framework on which to develop programs which will help assure a profitable future for this industry.

The following report, which summarizes the findings of the Task Group, is divided into several sections.

Sections 4.0 and 5.0 present profiles of the Canadian and New Brunswick software industries, respectively. In this context, it is important to note that the federal government has only recently begun attempting to build the framework within which statistics on this fast-growth industry can be gathered. As a result, our statistical analysis of the New Brunswick software sector, and indeed of the Canadian software sector as a whole, does not do justice to the witnessed growth. The 1987 survey used as the basis of the profile of the province's software industry was the most recent formal attempt to provide a statistical basis for the industry.

Section 6.0 of this report summarizes problems facing the local industry and offers possible solutions.

In Section 7.0, factors which support the development of a strong provincial software industry are discussed.

Section 8.0 contains information on emerging technologies which will play a key role in the development of the software industry.

Finally, Section 9.0 of this report contains a summary of the Task Group's suggested strategies for promoting the development of the New Brunswick software industry.

3.0 MANDATE OF THE TASK GROUP

The mandate of the Task Group is to recommend to the Management Committee of the Industrial Innovation and Technology Development Subsidiary Agreement a plan of action for further developing the New Brunswick Software Industry. Emphasis will be placed on those initiatives which are strategic in nature, address R&D opportunities, build on industry strengths, and pursue diversification in order to significantly increase employment within the industry. Industry cooperation and consultation with universities and governments is envisaged.

4.0 THE CANADIAN SOFTWARE INDUSTRY IN THE GLOBAL CONTEXT

Currently estimated at approximately $60 billion U.S., the world market for software is growing at a rate of over 20 percent per annum. The software industry is considered strategic by all government bodies interested in having a share of leading-edge technology markets.

Typically, software companies must invest considerable resources into research and development in order to ensure that their products keep pace with constant technological changes and therefore remain competitive. Significant marketing efforts are also required at home and internationally. Other problems intrinsic to this fast-growing industry include:

- increasing dominance and market consolidation by major computer hardware and peripheral manufacturers
- inadequate intellectual property protection in many foreign markets
- high product market segmentation due to function (system, user tool, application), utilization (business, manufacturing, engineering, health care, etc.), and support equipment (mainframe, minicomputer, microcomputer)

Industry consolidation and concentration is more advanced in the United States than anywhere else in the world. In fact, American leadership in the development and marketing of packaged software and turnkey systems is acknowledged worldwide. The American domestic market is the largest in the world; and American companies are responsible for 70 percent of worldwide software sales.

West European countries such as France, England, and West Germany have some strong software companies and large domestic markets for software. In recent years, European governments have begun to encourage and support the creation of numerous research and development consortia for the creation of strategic information technologies (for example, the ESPRIT and EUREKA programs). The results are promising.

The Japanese software industry is still lagging behind that of North America; but major efforts are being made as part of the fifth generation computer program to take an international lead in software R&D.

In 1986, the Canadian computer software, systems, and services industry consisted of 5,578 firms employing 34,601 people, with an estimated revenue of $2.85 billion. Statistics suggest that less than 10 percent of that total was derived from exports; and that export sales were concentrated in the area of packaged software. Currently, the rate of growth of the software industry surpasses the growth in any other sector of the Canadian economy.

The Canadian software industry sector consists of four industry subsectors (see Figures 1 and 2):

- ***Data Processing Services:*** This mature and largely Canadian-owned subsector markets such services as computer processing capabilities, access to data bases, network services, and data-entry services. Leading Canadian firms in this subsector include STM Systems Corp. and Dataline Inc.

- ***Software Products:*** Producing "packaged software" (whether ready-to-use, operating systems, or user tools), the majority of the firms in this subsector are small, underfinanced, and in search of appropriate international distribution channels (such as licensing agreements, distributors, value-added resellers, and electronic equipment manufacturers), primarily to the United States.

- ***Professional Services:*** Domestically-oriented and virtually all Canadian-owned, this subsector is made up of firms which provide consulting and custom software development services.

- ***Systems Integration:*** This emerging subsector consists of firms which compete to provide systems integrating hardware, software, and services in order to meet particular client needs. With major players such as SHL Systemhouse, DMR Group, and LGS, this is the fastest-growing of the four subsectors, primarily as a result of contracts with governments and large organizations in Canada and the United States.

Canadian software companies tend to be relatively small; but many, including small- and medium-sized companies, have a strong export orientation with internationally competitive products and services to market.

Number of Firms
In the Four Industry Subsectors

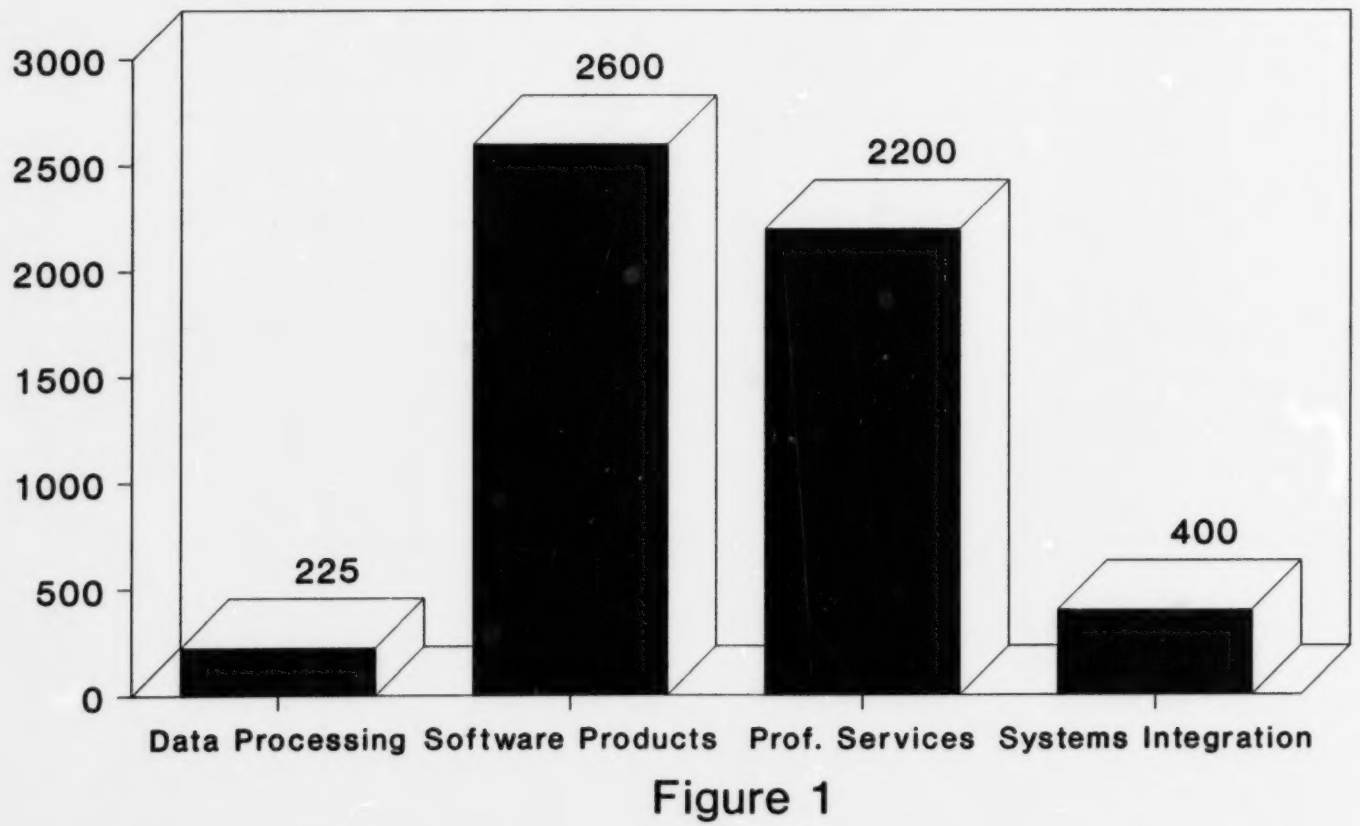

Figure 1

(Statistics Canada, 1986)

Percentages of Total Revenue ($2.85 b.) for the Four Subsectors

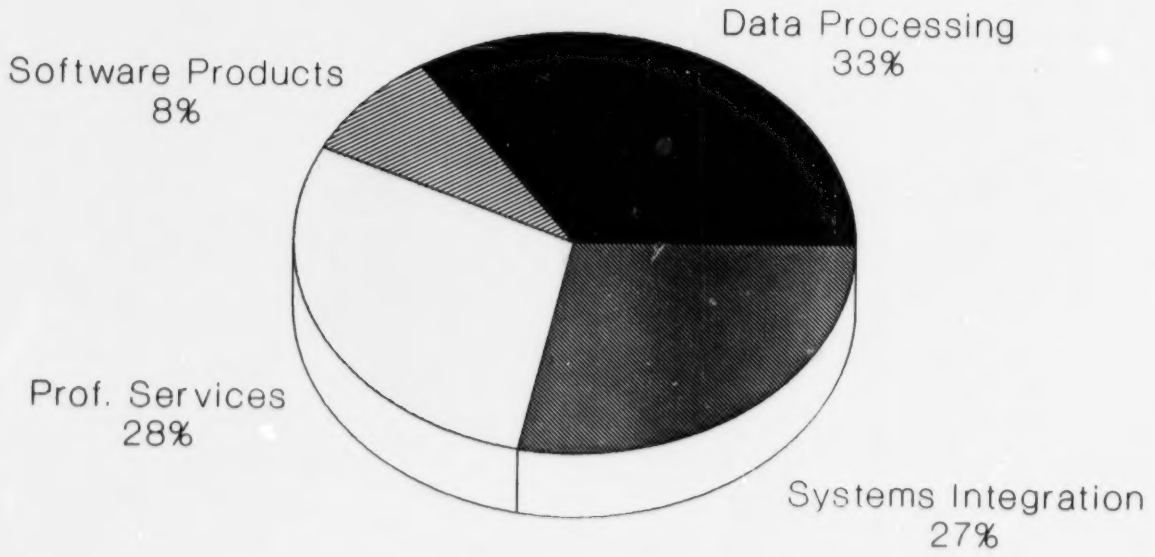

Figure 2

(Statistics Canada, 1986)

5.0 PROFILE OF THE NEW BRUNSWICK SOFTWARE INDUSTRY

The following profile of the New Brunswick software industry is based primarily upon data from two sources: the New Brunswick Software Industry Survey conducted by the Department of Commerce & Technology in October, 1987, and the 1989 New Brunswick Software Directory, also developed by Commerce & Technology.

Information on employment size and revenue size indicates that, like the Canadian software sector as a whole, the New Brunswick industry is comprised primarily of small, underfinanced companies.

While the 27 companies responding to the 1987 survey employed a total of 315 people, 80 percent of the companies employed 10 people or less. Most of the respondents predicted an increase in employment rate for the 1987-1988 period; and this prediction is borne out in the 1989 data, which indicates a slight employment increase (see Figure 3).

Twenty-six percent of the respondents to the 1987 survey indicated that they had a total revenue of $25,000 or less (see Figure 4); but 74 percent reported a projected increase in revenues from the sale of software products for the 1987-88 period.

While the companies as a whole have tended to remain small, the number of firms within the sector is steadily increasing. In 1987, the New Brunswick software industry was comprised of 47 companies. By 1989, however, this number had increased to approximately 66 software companies, a significant measure of just how quickly this sector is growing.

The majority of respondents to the 1987 survey were involved in either custom software development, packaged software development, or software consulting, or some combination of the three areas. Respondents were also engaged, to a lesser degree, in training, value added reselling, software distribution, and systems integration. None of the respondents were involved in software publishing (see Figure 5).

Four basic types of applications are produced by the New Brunswick software industry. These are:

- Resource Industry applications (comprising the agriculture, fishing, forestry, mining, and pulp and paper sectors)
- Service Industry applications (including retail, distribution, financial, and hospitality industries, as well as educational institutions and the medical profession)
- Manufacturing and Processing Industries (including printing, plastic, fish processing, and the food and beverage industries)
- Government (municipal, provincial, and federal, including military applications)

A breakdown of software product applications according to data from the 1987 survey (see Figure 6) shows that the major area of product application is within the province's Service Industries.

While the United States represents the largest market for Canadian software as a whole, this trend is not true of New Brunswick produced software in particular. The respondents to the 1987 survey indicated they sold most of their software products either within the province or within Atlantic Canada. Ontario also represents a fairly large market for local software developers (see Figure 7).

Informal statistics for the Department of Commerce and Technology indicate that, currently, several New Brunswick firms have made significant progress towards marketing software products in the United States and overseas.

The data suggests, then, that, while this is certainly a growth area, the typical firm in the New Brunswick software industry is small, employing less than 20 people, underfinanced, and lacking the marketing skills necessary in order to fully develop its products.

N.B. Software Companies
by Employment Size

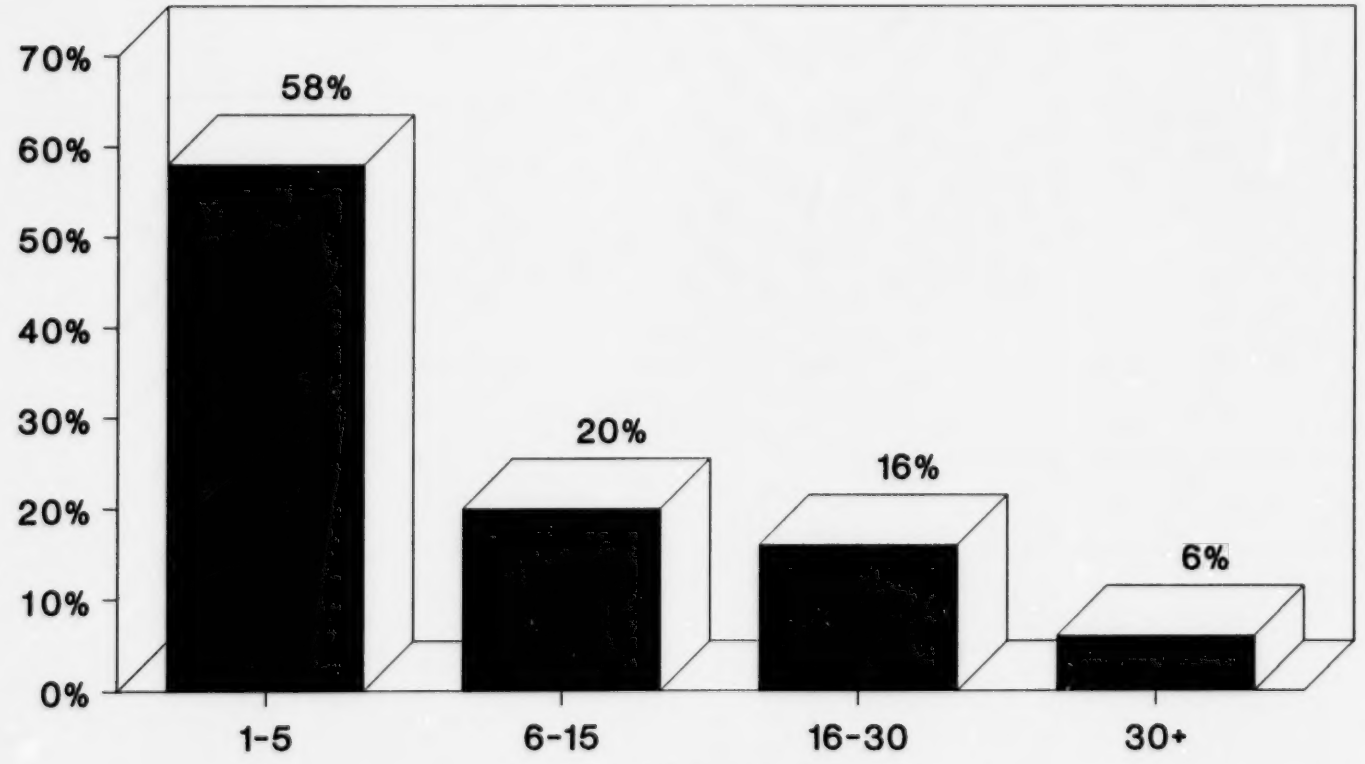

Figure 3

(Commerce and Technology, 1989)

N.B. Software Companies
by Total Revenue (1986-1987)

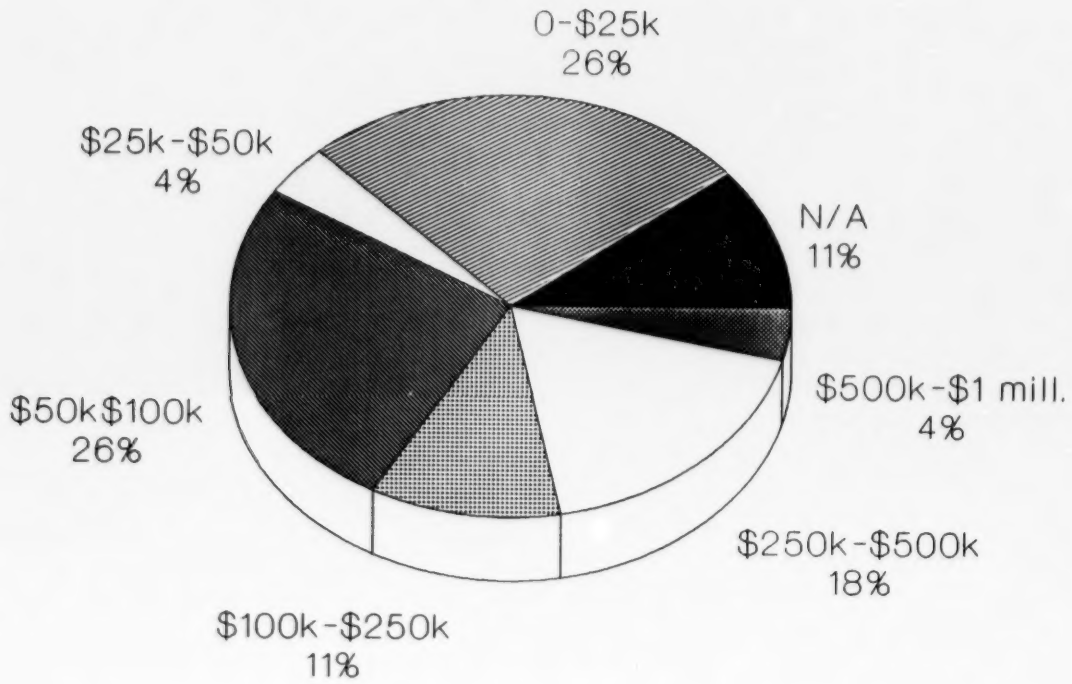

Figure 4

(Commerce & Technology, 1987)

N.B. Software Industry

Industry Classification

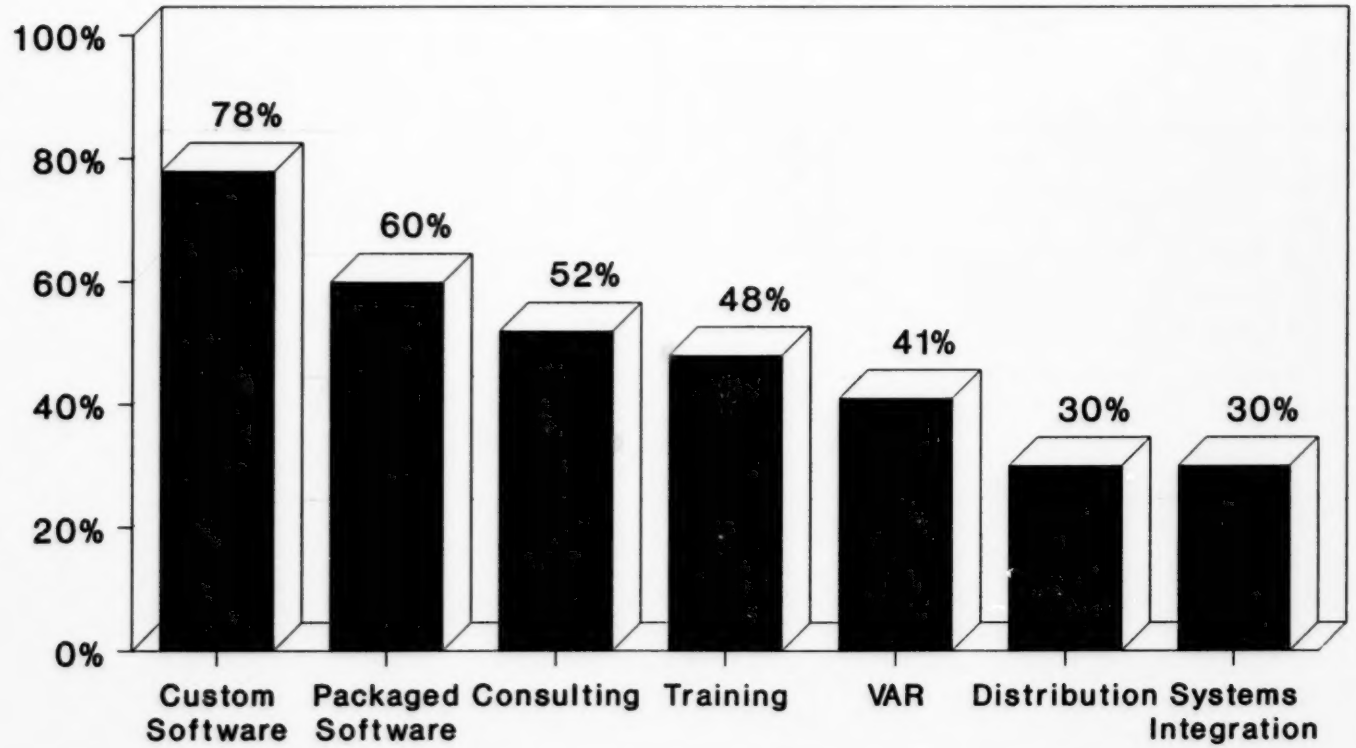

Figure 5

(Commerce & Technology, 1987)

The N.B. Software Industry
Software Product Applications

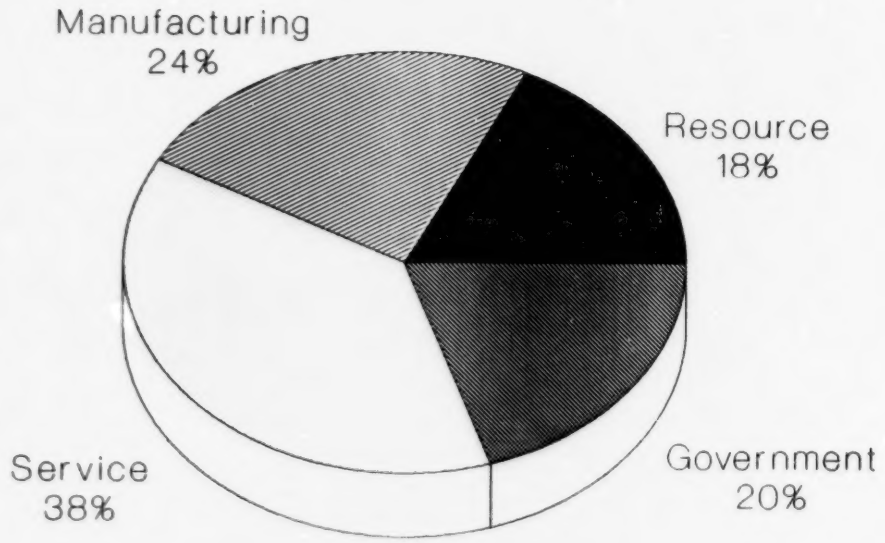

Figure 6

(Commerce and Technology, 1987)

The N.B. Software Industry
Software Markets

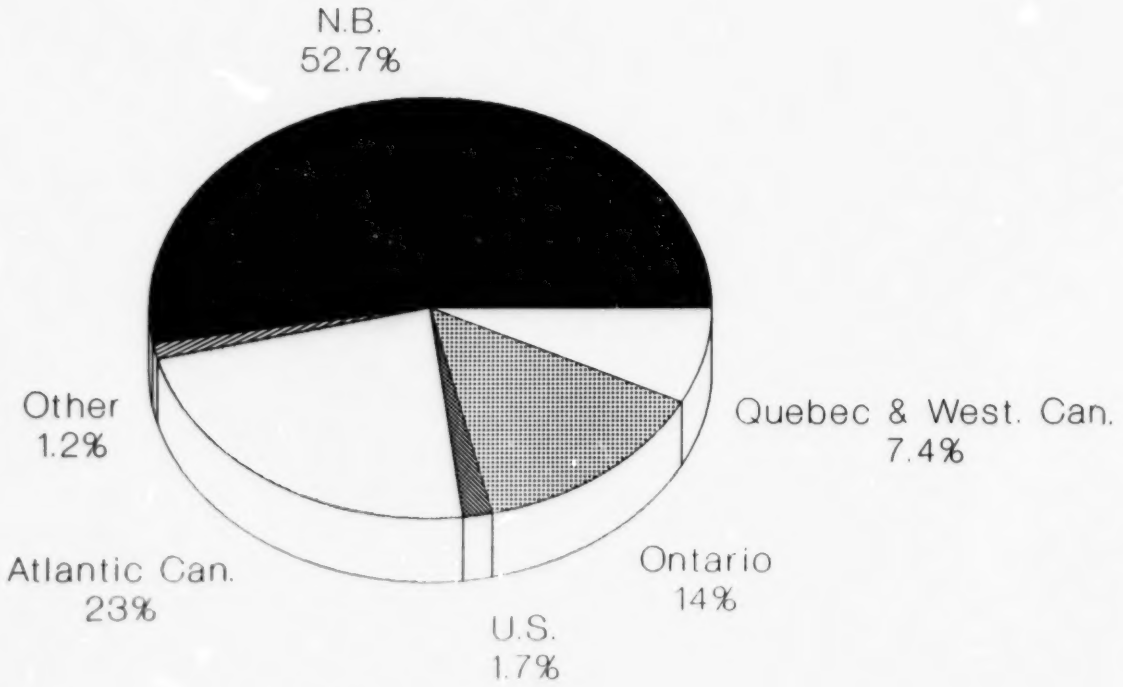

Figure 7

(Commerce & Technology, 1987)

6.0 PROBLEMS FACING THE NEW BRUNSWICK SOFTWARE INDUSTRY

6.1 Financing

6.1.1 The Problem

> *One problem faced by software developers, in particular, is their inability to arrange adequate financing from financial and other institutions, on terms which correspond with their proposed growth and development* (Industry, Science and Technology Canada, 1988).

Of the number of ingredients necessary for successful transfer of technology to the marketplace, none is perhaps as crucial as financing; for the lack of financing is the major cause of business failure. Unfortunately, the inability to derive an adequate investment capital or expansion funding from equity or debt sources is a national problem for software companies.

One reason for this inability to derive financing is a lack of communications. Software developers and potential financiers appear to communicate on different wavelengths, with the result that software developers are continually frustrated by the need to justify their activities and products to others who are essentially illiterate in the field, and who do not tend to view knowledge and information as commodities. This is an evolutionary problem; but some jurisdictions are evolving faster than others, either because of inherent advantages or because of policy initiatives.

A second reason for the failure of software developers to arrange adequate financing is that small software companies, with their intellectual inventory and minimal plant needs, rarely require one million dollars or more of venture capital (the amount expected by venture capitalists) in order to solve their expansion problems. To tailor financing to venture capitalists' desires or expectations, rather than to individual company needs, is a recipe for financial disaster or total loss of control -- neither of which is included in the plans of most entrepreneurs. In fact, some 65 percent of small businesses in the

province have indicated that they would not accept outside equity investment, even if it were available, because of a reluctance to place their control at risk.

Therefore, the relatively conservative financial needs of small- to medium-sized software companies and the very strong desire on the part of software developers to maintain control are factors which virtually exclude professional venture capital as a source of financing.

This is particularly true for software developers in Atlantic Canada. As pointed out in *Atlantic Business* (Cox, 1989):

> *Entrepreneurs in the Atlantic provinces have been virtually shut out of the multi-billion dollar venture capital spree that has swept the rest of the country since the early '80s. In fact, venture capital funds invested in Atlantic Canada represent less than one percent of those invested in the rest of the country.*

In the same article, Mary MacDonald, president of Venture Capital Economics of Toronto, is quoted as saying that, "Networks for the transferring of risk capital and management expertise are simply not in place in Atlantic Canada." As a result, although the Atlantic region has pension and endowment fund holdings of some $10 billion, these funds are almost entirely controlled in Toronto and Montreal. Until networks are put into place, or until the government begins to take an active role in the use of these funds, as it has in Quebec, Atlantic Canadian entrepreneurs -- particularly those in the software industry -- will not have access to the necessary equity funding.

Debt financing offers a partial alternative to equity financing. However, the picture is not much brighter here. Banks, which represent the major potential source of such funding, are understandably more concerned with protecting their depositors' money than with financing business development. For this reason, banks typically provide only limited lines of credit, require the personal guarantees of company officers, charge two percent over prime, and often insist on being paid before the shareholders.

Furthermore, banks do not recognize computer code as an asset and are extremely uncomfortable with intellectual property, even if it is captured in source code for a saleable and profitable commodity.

As examples of the difficulties involved in debt financing, consider Consumers Software Inc. and Chancery Software Ltd., both of Vancouver. On the basis of its electronic mail software, the former company has developed a formal strategic partnership with IBM Corporation. Consumers also has $5 million in sales and a strong growth record. Similarly, Chancery Software has experienced a revenue growth of over 50 percent a year for the past three years and has established a strong reputation in the software business. Both companies have been forced to finance expansion with their cash flow, although Chancery finally managed to obtain financing from a European bank at only one percent over prime, without the personal guarantees, and without the usual stipulation that the bank be paid first.

The net situation is that acquiring investment capital or expansion funding from either equity or debt sources is a national problem for software companies; and that this problem is exacerbated in Atlantic Canada because of the lack of proximity to the major financial centres and the lack of a networking infrastructure for the movement and management of capital.

6.1.2 Possible Solutions

It is apparent from the above that, for the time being, software developers will not find solutions to their financing problems in the private sector. This leaves the provincial government as a possible means of deriving funding.

The initiatives open to government in New Brunswick have been examined by the Conseil economique du N.-B. Inc. (1988), and the Conseil listed four possibilities:

- Public Stock Savings Plans (SSP)*
- Registered Investment Business Plan (RIBP)
- Provincial Holding Company
- Participating Debentures

The first approach, the Stock Savings Plan (SSP) would be based on that developed in Quebec, where the program has been extremely successful. However, because of significant differences between New Brunswick and Quebec with respect to the percentage of potential investors (high income earners) and the number of eligible companies, the Conseil cautions that the SSP should "not be seen as a major economic development program in N.B." Recommendations included universality with respect to eligible companies, highest possible tax credits, and an increase in support for the cost of first issuance of shares.

The second approach, the RIBP, would be modelled on the RRSP system, with the exception that the money would have to be used in the start up or expansion of a business. The plan would also be open to managers and employees of small- and medium-sized businesses.

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* In the time since the committee first discussed this point, the province has begun implementing this program.

A third approach would involve the government in using its leverage with respect to pension funds in order to promote the establishment of a provincial holding company. Because of the source of the funds, however, the money would only be available for participation in the equity of large businesses.

While all these programs fill a need and would help to stimulate investment in New Brunswick companies in general, they would do little in the short term to help the province's software companies in particular.

Clearly, an alternative approach to financing is needed; and this need may be best met by the fourth alternative: the Participating Debentures proposal. Under this program, the Department of Commerce and Technology would provide eligible businesses with an interest-free loan, with a percentage repayment based on sales. A debentures program is currently available through a number of federal and provincial agencies, such as ACOA; but the program should be expanded to cover operating capital.

6.1.3 Conclusion

The Information Age is here, but has yet to be fully understood or appreciated by traditional financial institutions. This is evidenced by the general lack of understanding of the software business, the incompatibility between software entrepreneurs and venture capitalists, and the failure of banks to appreciate computer code as collateral. Add to this the absence of a financial infrastructure, and the net result is that debt and equity financing from the private sector are simply not available to New Brunswick software companies. Commerce and Technology and ACOA should give serious attention to orienting their loan guarantee and direct loan programs towards the special needs of the software industry.

6.2 Access to Technology and Training

6.2.1 The Problem

If New Brunswick software companies are to remain on the leading edge of development, it is vital that they have timely and on-going access to information, training, and technology. However, because most courses and trade shows tend to take place in locations outside of Atlantic Canada, maintaining this access to technology and training places a severe financial burden on New Brunswick software developers. In addition to the course fees, software companies in the province must expect to pay travel costs, lodging, meals, and other miscellaneous expenses – with the net result that the vital training and technology are virtually inaccessible to many New Brunswick software companies.

Adding to this problem is the fact that – because of the fragmentation of this dynamic, fast-growing industry – New Brunswick software companies may not even be aware of all the courses and trade shows available in Atlantic Canada and elsewhere.

Federal Training Assistance Programs which serve to defray the cost of training are available from Employment and Immigration Canada. However, a company is only eligible for financial assistance through these programs if the course being attended lasts two weeks or longer.

The Department of Commerce and Technology provides assistance for out-of-province training for short courses (up to five days in duration).

These programs provide support for companies obtaining training out of province, but do little in the way of developing local services.

6.2.2 Possible Solutions

The most promising short-term solution to the problem of limited access to technology and training is to change the emphasis of training such that more courses and trade shows take place within the province.

In order to achieve this end, the proposed New Brunswick Software Industry Association (see Section 9.1.2 of this report) must aggressively identify and promote appropriate local courses for the industry, and then work together with the provincial government to implement these courses. In addition, the Association should assist interested private and public educational institutions in the province with organization for the delivery of appropriate training programs.

The provincial government should also provide incentives and/or facilities for holding courses and training seminars in New Brunswick. Such incentives would include:

- guaranteeing a minimum participation level for a course offered locally by the private sector
- promoting the use of both public sector resources (such as universities and community colleges) and the expertise offered by government employees in local training programs
- attempting to lure those out-of-province agencies offering training to New Brunswick by offering to cover any additional costs incurred by travelling to the province
- promoting and maintaining the marketing assistance programs that are aimed at increasing the level of marketing expertise within the industry

6.3 Local Market Acceptance and the Image of the Industry

6.3.1 The Problem

The New Brunswick software industry casts a rather small shadow; and local businesses and government agencies tend to perceive the industry as having little to offer. This industry image can be attributed to several factors.

First, the New Brunswick software sector, like the Canadian software industry as a whole, is still in an early stage of development. Its marketing infrastructure is relatively undeveloped; and the industry itself is fragmented, consisting of many small companies which do not tend to pool their resources for joint ventures or cooperative efforts.

Second, few of these small companies have yet reached the point of *critical mass* -- that is, the size at which human and financial resources are sufficient to address major projects or development work.

Finally, the public in general does not understand the capabilities of the software sector and its pervasiveness in the New Brunswick economy. Governments do not have sufficient data on the software sector to assess its potential to solve local information requirements.

6.3.2 Possible Solutions

In order to improve the New Brunswick software industry's image, the government should:

- establish a bulletin board containing Application Software solutions developed and supported by local software firms.
- undertake to use the media more effectively in order to market the New Brunswick software industry as a whole.
- promote the formation and encourage the acceptance of a Marketing Consortium which would strive to improve local market acceptance and image.
- promote local software capabilities internally, within municipal, provincial, and federal organizations.
- assist in the wide dissemination of the Software Industry Directory.

6.4 Human Resources

6.4.1 The Problem

The software industry in New Brunswick suffers from a general depletion of skilled, experienced human resources. This depletion encompasses virtually all types of employees required by the industry, including programmers, systems analysts, marketers, and technology experts.

This problem is not the result of an insufficient number of graduates from Computer Science and other related programs in New Brunswick. In fact, New Brunswick universities and community colleges produce approximately 110 Computer Science graduates each year, certainly more than enough to supply an industry that employs approximately 500 to 600 people. Locally, rather, the problem is related to how likely skilled people are to come to, or to remain in, New Brunswick.

One significant reason for the New Brunswick software industry's inability to attract skilled employees is its poor image (as discussed in Section 6.3 of this report). Many people, including potential employees, are simply unaware of the employment opportunities offered by the province's software industry, and therefore do not apply for positions with New Brunswick software firms.

Compounding the problem is the high visibility of the software industry elsewhere, especially in Ontario and Quebec. Many New Brunswick university graduates in Computer Science are successfully recruited by large, out-of-province firms such as Bell Northern Research and IBM. The New Brunswick universities involved estimate that between 60 and 75 percent of their Computer Science graduates are hired immediately by out-of-province firms. One reason for this is that large firms can predict their personnel requirements months in advance, and can thus recruit and hire potential graduates four to six months before graduation. The smaller New Brunswick firms tend

to recruit when needs are immediate, and therefore often miss the opportunity to hire graduating students.

The larger industries, such as those in Ontario, also attract more employees because they offer several significant advantages for software industry professionals. First, the market for software services in the larger centres tends to support higher prices for services than does the local New Brunswick market. This in turn supports higher salaries for personnel. Second, because larger centres offer a greater number and variety of jobs, an individual's chances of finding a gratifying position are increased. The greater availability of positions in the field also makes it possible for software professionals to *job hop*, or change jobs regularly, as a means of advancing their careers. Job hopping tends to increase competition for personnel, thereby raising salary levels.

Of course, New Brunswick also offers benefits which might be used to attract people to work in the New Brunswick software industry. The cost of living in the province is lower than in some larger centres and can thus be used to justify lower salaries, or to make a salary level comparable to that available in a larger centre more attractive. Many New Brunswick software firms are small and young, and thus offer opportunities to "get in on the ground floor" of a new business. New Brunswick offers a "non-big-city" lifestyle that some find attractive. Finally, there is a perception that a large number of people originally from New Brunswick and working in other centres would consider returning to the province if given the incentive of comparable employment opportunities.

Unfortunately, despite these advantages, the total effect of all of the above factors is that the New Brunswick software industry has an extremely difficult time attracting sufficient skilled human resources.

6.4.2 Possible Solutions

There are several possible ways of alleviating this problem:

- Use generic promotions and other strategies to improve the software industry's image in the eyes of potential employees, such as graduating university and college students.
- Publish a directory of industry employers and distribute this directory to potential employees.
- Promote government programs, such as an Internship Program, to aid in attracting employees to the New Brunswick software sector. Such programs should not focus strictly on technical employees, but should also provide assistance in filling marketing, managerial, and other non-technical positions.
- Provide potential software industry employers with frequently updated lists of cooperative workterm students, future Computer Science graduates, and Computer Science alumni.
- Advertise job opportunities in university and college alumni newsletters across the country.
- Provide New Brunswick software developers with opportunities -- such as conferences and seminars -- in which to showcase their R&D projects and achievements to potential employees.
- Invite universities to include business-oriented courses (such as entrepreneurship) in their Computer Science programs, in order to encourage the creation of new firms and opportunities.
- Offer more business skills and entrepreneurship training in order to encourage graduates to consider starting their own software businesses in New Brunswick, thereby ensuring that their skills and expertise remain in the province.

6.5 Government Procurement Policies

6.5.1 The Problem

6.5.1.1 Overview

The governments' purchasing power has the potential to contribute enormously to the future success of the New Brunswick software industry. Unfortunately, however, the procurement policies of both the federal and provincial governments are based upon an evaluation of requirements with respect to a company's revenue stability/level, assets, size, and past history, and do not tend to promote small New Brunswick software companies.

The federal government has in place distinct procurement policies designed to encourage small- to medium-sized Canadian businesses. In the software sector, managed through the OASIS group of Supply and Services, federal policy includes:

- the division of large projects into smaller parts
- requiring a certain percentage of projects to be subcontracted to small companies
- a move away from in-house development

There are, however, many instances where these policies are not followed, particularly in the area of regional development. Consequently, most contracts for nationally-used computer systems are filled within the National Capital Region, making it extremely difficult for small New Brunswick software companies to compete effectively at this level.

The provincial government is the largest single purchaser of goods and services in New Brunswick, and therefore has a major impact on many areas of the economy, including the software sector. Therefore, the methods by which the province acquires computer

software -- whether through product development opportunities, in-house development, or out-of-province purchases -- are of vital concern.

6.5.1.2 Product Development Opportunities

Opportunities for product development are of prime importance, since most successful computer programs are initially developed for a specific client in order to solve a specific problem. The software company then generalizes the system so that it will appeal to a broader market.

Unfortunately, the provincial government rarely provides New Brunswick software companies with the opportunity to develop customized software. Instead, time after time, government departments look to out-of-province solutions without even considering local capabilities.

There is no doubt that the software industry in New Brunswick has both the ability and the resources to produce world class software -- for example, the CARIS geographic information system, produced by Universal Systems. However, until the provincial government provides more development opportunities to the private sector, the full potential of our computer companies and people will not be realized.

The following areas are currently under development or implementation within the provincial government, and would have been excellent candidates for local involvement:

- Human Resources Information System
- Province-wide library system
- Hospital and health care systems
- Community College Student Information System
- Records Management and Document Tracking Systems

These systems all have a broad commercial appeal which could easily have been exploited by New Brunswick software companies, had they been involved in the product development.

6.5.1.3 In-House Development

The Department of Supply and Services maintains a large Information Systems Group (ISG) for the development and maintenance of computer systems required by government departments. This practice does nothing to stimulate the private software sector, and in certain cases is even detrimental to the industry. For instance, since ISG bids on many projects which are put out to public tender, private companies must compete with a government agency to win government contracts.

Private sector software development, however, offers several economic advantages over in-house development:

- The developed software product can be generalized and exported to other markets, leading to a positive influx of wealth into the New Brunswick economy.
- The expertise gained during the development phase is retained by the company and can be applied to other areas (and can also be exported).
- Creation of new permanent jobs is much more likely to occur within the private sector environment.
- Private companies can allocate resources more efficiently in order to meet changes in demand for development services. For example, unlike the government, a company can transfer employees who have no current assignments.

6.5.1.4 Out-of-Province Purchases

Many provincial departments have purchased computer software from out-of-province sources, including other provinces and the United States. It is acknowledged that local software companies' inadequate marketing strategies are partially to blame for this state

of affairs. However, while the present New Brunswick software industry can make no pretence at meeting every requirement, many provincial departments clearly do not believe that the local industry is capable of meeting their needs; and there seems to be little motivation on the part of the departments to investigate local capabilities and resources.

Obviously, choosing a new solution over a known quantity involves a degree of risk; and it is possible that many decisions favouring out-of-province products and services are made because they are "safe". Some reinforcement and encouragement from the ministerial level will be required to change these attitudes.

6.5.2 Possible Solutions

- ***Decentralize Federal Procurement Policies:*** Supply and Services Canada should encourage more decentralization of computer projects. Establishing pilot projects in different regions would be an excellent way of developing systems with a view to eventual implementation on a national scale.

- ***Reduce In-House Development:*** Reduce all provincial government in-house development to a minimum, and contract work out wherever possible.

- ***Buy New Brunswick:*** Encourage all departments to investigate local capabilities before acquiring computer software or services. Preference should be given to New Brunswick companies (those companies whose head office and majority ownership is in New Brunswick).

- ***Local Involvement:*** Whenever work is contracted to out-of-province suppliers, the government should insist on some local involvement in the project. Technology transfer must occur in order to give local companies a chance to compete on the national and world markets.

- ***Offset Program:*** If the province purchases non-computer goods or services from an out-of-province supplier, it should request that the supplier spend offset credits on New Brunswick computer software and services.

- ***Build vs. Buy:*** Whenever a required software package cannot be found locally, a study of the feasibility of developing the package should be performed.

- ***Industry Consortium:*** Form an industry association as a means of informing software developers about government procurement policies and ways in which to adapt to these policies. It is also possible to bid on government contracts as a consortium.

6.5.3 Conclusion

Since the province's purchasing power has the potential to contribute enormously to the future success of the New Brunswick software industry, it is essential that the provincial government change its current attitude from that of being merely a "purchaser of computer goods and services" to one of becoming a partner with the private software industry. Government and the software sector should work together to examine current computer system requirements and to develop solutions that will not only meet the immediate needs of the province, but that will also boost the growth of the software industry and help to stimulate the New Brunswick economy as a whole.

6.6 Marketing New Brunswick Software

6.6.1 The Problem

Most New Brunswick software companies, like most independent software manufacturers across Canada, are small; and their resources in terms of marketing and financial management are limited. Although they have proved themselves in the design of "vertical market" applications, New Brunswick companies must develop their capacity to market and export these applications.

Thus, one of the greatest challenges facing New Brunswick software companies, and Canadian software companies as a whole, is marketing their products. Although these companies employ a large number of technical personnel, marketing experts are extremely rare. The situation is aggravated by the fact that few software companies perceive a need to hire competent persons to oversee the marketing of their products.

The high costs involved in marketing software also have a significant influence on the ability of the small New Brunswick software companies to market their products.

6.6.2 Possible Solutions

The Task Group suggests several ways of overcoming these problems:

- Establish government procurement programs (see Section 6.5.2 of this report for details regarding the development of such programs).

- Make efforts to encourage ties between small New Brunswick software companies and larger software firms in the province. Such ties would be mutually beneficial. The small companies would benefit because:

  * the large firms have access to established distribution networks

  * the large firms are more client-driven than product-driven, as are the small companies

  * the large firms have solid infrastructures

  * the large firms have marketing expertise (for example, market study, packaging, advertising, and price-setting) and have money with which to finance marketing and new product development

  For the large firms, such alliances would also offer several advantages:

  * the small companies are much more flexible at the operational level than are the large firms

  * the small companies employ competent and very innovative personnel

  * the small companies are more product-driven

  * the small companies can adapt much more quickly to changes than can the large firms

- Organize government-sponsored "marketing manager" internship programs, which may serve to convince software companies of the need to acquire proper marketing expertise.

- Offer continued government support of a series of seminars and conferences with "Marketing Software" as the theme.

6.7 Liaison between Industry, Universities, and Governments

6.7.1 The Problem

Given the infancy of the software industry in the province, and the relatively mature state of the industry in other parts of North America, the Task Group is convinced that the New Brunswick software industry is not likely to become a viable entity without a coordinated effort between the industry, universities, and government.

6.7.2 Possible Solutions

The Task Group proposes that the government create an organism or mechanism (see Figure 8) which would maintain communication and cooperation between the software industry, the universities, and the government in order to fulfill the following objectives:

- to continue to provide direction and recommendations to the government relative to the development of the software industry
- to improve the coordination of activities between parties and thereby avoid duplication of effort
- to discuss ways in which to implement the recommendations made in this report
- to encourage liaison between industry and universities regarding common issues and concerns
- to identify new opportunities in the software industry

Structure of Proposed Liaison Group

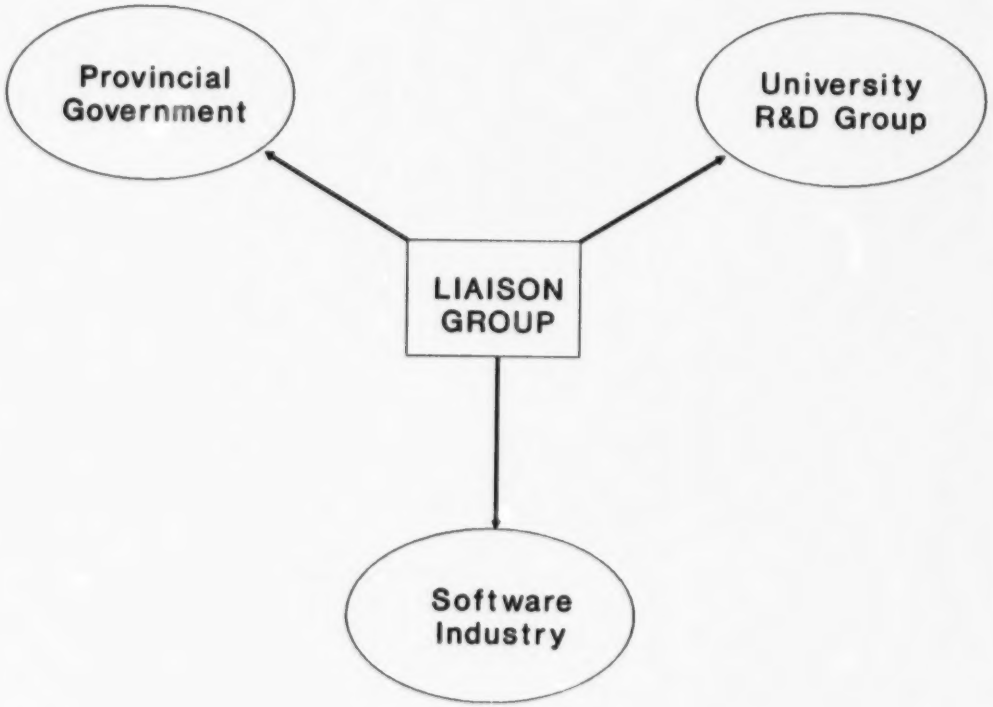

Figure 8

6.8 Funding of Current Hardware and Software at the University Level

6.8.1 The Problem

Two developments during the past ten years -- the decrease in per-student funding and the increasing cost of workstations and associated software -- have had the combined effect of precipitating a near crisis in Computer Science education.

During the past ten years, government funding of Maritime universities, on a per student basis, has fallen over 20 percent, taking inflation into account (Association of Atlantic Universities, 1988). Non-salary funding decreases on the same basis have been much higher.

This decrease in funding alone would have profound effects on the quality and nature of Computer Science education. However, taken in conjunction with the high cost of computer workstations -- on the average, five to ten times the cost of a personal computer (PC) -- its consequences could be devastating.

Workstations are extremely powerful microcomputers which are essential to Computer Science education. Possessing at least ten times the memory and power of a PC, workstations run sophisticated operating systems (such as OS/2 and UNIX) which support graphic and communication interfaces.

For many purposes, workstations built before 1985 are considered obsolete. Nevertheless, much of the hardware and software currently found in undergraduate computer labs dates from the late 1970s and early 1980s. Moreover, the ratio of students to PCs is twenty or more to one, with the result that labs are being operated past midnight and students have little or no access to workstations and corresponding software, such as CASE (Computer Aided Software Engineering) tools. Far too much of the Computer Science budget goes toward maintaining this outdated equipment as opposed to purchasing newer and better equipment and software.

The situation is critical, especially in light of the predicted drop in the price of workstations by 1995. It is anticipated that workstations will soon be pervasive in the workplace; and it is therefore essential that undergraduate students be given the opportunity to train on this equipment now.

6.8.2 Possible Solutions

The activities and development of Computer Science at both the Université de Moncton and the University of New Brunswick have a great impact on the New Brunswick software industry. This being the case, the Task Group believes that the provincial government should:

- provide a capital investment or subsidy in order to bring equipment in the Computer Science departments to a level comparable with that in other provinces.
- increase yearly financial support to Computer Science programs so as to keep up with ever-changing hardware and software requirements.

7.0 FACTORS FAVOURING THE NEW BRUNSWICK SOFTWARE INDUSTRY

7.1 Business Support

Given the predominance of small firms in the New Brunswick software sector, existing and potential members of the industry can benefit from a number of programs aimed at promoting small business in the province. In addition, there are several programs specifically designed to promote technologically-oriented businesses in the province. Programs supporting small and technologically-oriented businesses include, but are by no means limited to, the following:

- ***The Innovation Centre N.B.:*** The innovation centre provides potential entrepreneurs with advice pertaining to the commercialization of technology.

- ***Incutech Brunswick Inc.:*** Located in Fredericton, New Brunswick, Incutech is an incubation centre designed to assist in the development of new, technologically-oriented ventures. The centre provides new companies with reasonably-priced office space and services, and facilitates their access to expertise.

- ***The Strategic Technologies Program:*** Created and administered by Industry, Science and Technology Canada, the purpose of this program is to help Canadian companies establish alliances with other firms, universities, or research institutes in order to develop or apply technology.

- ***The Canada/New Brunswick Subsidiary Agreement on Industrial Innovation and Technology Development:*** This is a joint agreement between the governments of Canada and New Brunswick to promote the development and application of technology in New Brunswick. The program accomplishes this goal by providing funding for appropriate, technology-oriented initiatives. For example, the Innovation Centre N.B., mentioned above, is funded under this agreement.

- ***Self Start (New Brunswick):*** Administered by the New Brunswick Department of Commerce and Technology, this program provides personal loan guarantees for first-time owners of new small businesses.

- ***The Atlantic Canada Opportunities Agency Action Program (ACOA):*** The ACOA Action Program provides funding to aid in the establishment and operation of strategic businesses in Atlantic Canada.

- ***Industrial Research Assistance Program (IRAP):*** This program is delivered and administered by the National Research Council and supports projects including software development.

The Task Group strongly recommends that the above programs and services be continued and augmented in the foreseeable future.

7.2 The Post-Secondary Education System

The Province of New-Brunswick is served by many post-secondary institutions, including four degree-granting universities with seven campuses, a network of nine community colleges, and many private colleges.

The universities are:

- Université de Moncton (U de M), with campuses in Edmundston, Shippagan, and Moncton
- University of New Brunswick (UNB), with campuses in St. John and Fredericton
- Mount Allison University (Mt. A) in Sackville
- St. Thomas University (STU) in Fredericton

The New Brunswick Community Colleges (NBCC) have campuses in Bathurst, Campbellton, Dieppe, Edmundston, Moncton, Newcastle (NBCC Miramichi), St. Andrews, St. John, and Woodstock.

7.2.1 Degrees Related to Computer Science and Marketing

Since the Task Group believes that disciplines related to either Computer Science or Marketing are most likely to benefit the software industry, we will focus on these two fields of study.

7.2.1.1 Computer Science Programs

Three of the four New Brunswick universities grant degrees in or related to Computer Science. The University of New Brunswick offers a Bachelor, a Master, and a PhD in Computer Science; the Université de Moncton offers a Bachelor in Applied Computer Science; and Mount Allison University offers a Bachelor in Mathematics with what

amounts to a minor or concentration in Computer Science. The New Brunswick Community Colleges offer a program in Computer Programming.

A very brief description of these programs follows:

- The UNB PhD of Computer Science is described in the Graduate Calendar as being "primarily a research degree" in which "the major emphasis is on the thesis which must make a contribution to knowledge in the candidate's field of study."

- The UNB Master of Computer Science (MScCS) has two formats: in the Research Format, degree requirements consist of six courses and a thesis; requirements in the Study Format consist of eight courses and a report.

- The UNB Bachelor of Computer Science (BScCS) offers a co-op program -- that is, a program which requires students to alternate study with practical work. The BScCS offers four areas of concentration from which to choose: Hardware Systems, Software Systems, Numerical and Statistical Computation, and Information Systems.

- The U de M Baccalauréat en Informatique Appliquée (BIA, Bachelor of Applied Computer Science) emphasizes Software Systems and Information Systems, but also offers basic instruction in Hardware Systems and Numerical and Statistical Computation.

- The Mt. A Bachelor of Mathematics provides what amounts to a minor in Computer Science. For transfer purposes, the Technical University of Nova Scotia (TUNS) will recognize the first two years of the program as equivalent to their Computer Science program.

- The New Brunswick Community Colleges (NBCC) offer a two-year Computer Programming Technology program at the Bathurst, Moncton, and St. John campuses. The program is largely oriented toward teaching programming languages.

7.2.1.2 Marketing Programs

In New Brunswick universities, marketing is not offered as a distinct discipline, but is rather taught as a sub-discipline of Business Administration. UNB and U de M offer both a Master and a Bachelor of Business Administration, Mt. A offers a Bachelor of Commerce, and the NBCC offers a Business Technology program.

A very brief description of these programs follows:

- The U de M Baccalauréat en Administration des Affaires (BAA) consists of two years of standard coursework, followed by a concentration in either Marketing, Accounting, Finance, MIS (courses taken primarily through the Computer Science faculty), Management, or Business Quantitative Methods.

- Students in the UNB Bachelor of Business Administration program are not offered the option of a concentration. However, the standard course offerings include over half a dozen term courses in Marketing.

- Like U de M, Mt. A offers a variety of options -- including Marketing -- in its Bachelor of Commerce program.

- The NBCC Business program offers three areas of concentration: Marketing, Data Processing, and Business Automation. The Marketing option is offered at the Dieppe, Moncton, and St. John campuses.

8.0 STRATEGIC TECHNOLOGIES OF IMPORTANCE TO NEW BRUNSWICK

The following sections provide a brief outline of some of the tools and technologies of importance for software development in the 1990s, and their corresponding computing environments. Government agencies and developers can use this list of tools and technologies as a guideline in the evaluation of software related projects and proposals. However, it should be noted that the tools and technologies listed are not exhaustive, and that rapid developments in computer technologies may add to the list.

8.1 Target Computing Environments

The 1980s witnessed an explosive growth in the development and use of computers. Since the personal computer (PC) was first introduced in the 1980s, an estimated 50,000,000 have been sold in North America. During the past five years, rapid progress has been made in the development of computer networks, and in the development of workstations which have graphic interfaces and which are at least ten times more powerful than the original PCs. Such developments in computer technology mark the transition from centralized (or mainframe) to distributed computing, and this transition is expected to accelerate in the 1990s.

During the 1980s, most PCs used DOS (Disk Operating System), which was initially designed to support a single-user, stand-alone microcomputer. Today's advanced PCs and workstations, however, require much more powerful operating systems. Two operating systems in particular are expected to dominate the market during the 1990s:

- OS/2 for computers using INTEL 286, 386, and 486 CPU chips
- the UNIX type of operating system for multi-vendor workstations

Both of these operating systems have graphic interfaces which were pioneered by Apple; and both systems are still undergoing development.

Distributed systems require networking and communications software. The TCP/IP software which supports both wide-area and local-area networks and multi-vendor hardware environments is currently very popular. Proprietary systems are available from major computer vendors, such as NOVELL; however, such systems are not apt to be as flexible as TCP/IP. Worldwide standards for network communications are being developed, and TCP/IP systems are expected to adopt these standards in the future.

8.2 Tools and Technologies for Software Development

Recent years have witnessed the emergence of several technologies which are being incorporated into the software developer's toolbox, and which are expected to play a strategic role in facilitating computer applications development during the next decade. Three of these new technologies which are of particular importance are Artificial Intelligence, CASE tools, and Geographic Information Systems.

The synergy of these new technologies tends to produce higher value-added software products which have a "multiplier" or "leveraging" effect in the areas where they are applied. In other words, these software technologies tend to reduce costs, improve quality, and provide a means of developing new and better products.

8.2.1 Artificial Intelligence (AI)

AI consists of a variety of areas which attempt to extend the computer's "number-crunching" and character manipulation abilities toward matching the intelligence of a human expert in some limited sense. Research and development in all AI areas is very active at the present time.

AI technologies may be classified as follows:

- *Expert Systems:* Expert systems model the knowledge and expertise of an expert, such as a doctor, mechanic, or stock broker. They generally consist of three components -- a knowledge base, an inference engine, and a system shell or user interface. Expert systems are now being applied in a wide variety of areas, from medical diagnosis to school scheduling. The knowledge representation used in the data base must handle both quantitative and qualitative knowledge, and allow new knowledge to be inferred from a basic set of facts. The representation of general principals as well as specified situations must be allowed. Rule-based expert systems, capable of explaining reasons for decisions made, are currently very popular.

  The term "knowledge engineering" applies to the process of extracting and formalizing the rules used by the human expert, and of representing the knowledge in the data base. This process is critical to the successful

application of expert systems. Knowledge engineers are currently in short supply.

- ***Natural Language Understanding and Processing:*** These systems are beginning to be used to assist human translators (for example, from English to French). Natural Language interfaces also make it possible to conduct data base inquiries simply by typing a question in natural language.

- ***Pattern and Speech Recognition:*** These computers are being used to scan machine- and hand-printed characters, and to identify fingerprints, blood samples, and other well-defined items. Speech recognition systems with a limited but expanding vocabulary are being developed; and it is predicted that systems with direct input to a word processor will be marketed sometime during the 1990s.

- ***Computer (Robot) Vision:*** These systems are finding increasing application in industry for inspection, measurement, and the alignment of parts. Most of these are "co-operative vision systems" -- that is, they make use of special structured lighting and operate in a well-defined environment. Computer analysis of two- or three-dimensional scenes is currently a very active research area.

- ***Intelligent Tutoring Systems:*** Intelligent tutoring systems are being designed to improve upon the present methods of computer-aided-instruction. They do so by capturing the knowledge used by expert instructors and then building computational models of the pedagogic process. These models enable the systems to make pedagogical decisions which take into account each student's knowledge and ability. Since they allow for self-paced instruction, intelligent tutors have been found to be particularly effective in teaching students with certain types of handicaps. There is wide application for these systems in business and industry, as well as in schools. They can be used to train employees on new products and procedures on an individual basis, rather than sending them on expensive courses out of town.

- ***Machine Learning:*** Machine learning plays a part in all AI areas, and improvements in this area will enhance all AI products. Currently, research in neural networks is very active, and software products which stimulate neural networks are readily available. Implementations in hardware, such as VSLI chips, will allow for parallel computations and hence very fast decisions.

AI technologies are beginning to be applied in New Brunswick and they have the potential for widespread application in business, industry, and education. The University of New Brunswick has established an AI research group and a modest laboratory to promote the development and transfer of AI technologies. The provincial government

must support these efforts if AI technologies are to reach their potential in New Brunswick.

8.2.2 Geographic Information Systems (GIS)

A Geographic Information System is a computerized system which can reside on microcomputers, minicomputers, or mainframes, and which is used to create, manage, and integrate data bases. Relating thematic or attribute data to a geographic reference is the main-stay of GIS Technology.

Since GIS is capable of assisting in the management of information, the technology is strategic to the computer industry generally, and to New Brunswick in particular. Information is rapidly becoming the currency of our time; and the more efficiently that currency is managed, the greater the return which it can provide.

GIS is moving into all disciplines. It currently has applications in utilities and municipal infrastructure administration, resource management, environmental management, hydrographic and marine sciences, and property mapping. GIS can be applied to any area which involves the generation, processing, or manipulation of data.

GIS technology is alive and well in New Brunswick. However, if GIS is to remain healthy and grow, the provincial government must provide continued support. Given that support, the technology will continue to create employment in the province and, at the same time, will provide users in both industry and government with better tools with which to manage information in their day-to-day work activities.

8.2.3 Computer Aided Software Engineering (CASE) Tools

Typically, software developers approach the design process by drawing diagrams and writing documents. CASE tools provide support for developers by helping them draw the diagrams and prepare the written documentation about the software systems. Advanced CASE tools are capable of providing support for "coding," or constructing, the software systems defined by such diagrams and documentation.

Prominent commercial CASE tools include "Excelerator" by Index Technology Corp. and the "Information Engineering Workbench" by Knowledgeware.

Given the fact that the amount of effort required to build a software product affects both the production cost and the "time to market" of that product, a software producer's ability to develop software quickly and efficiently is of vital importance. Since CASE tools are meant to promote such efficiency, they are viewed by many as a strategic technology for software developers in the 1990s.

8.2.4 Application Areas of Importance to New Brunswick

The following application areas can benefit from or are currently benefitting from use of the tools and technologies for software development described above:

- industry-specific business management and information systems
- expert system applications in the forest, lumber, and power industries
- natural language processing to assist with French-English and English-French translation
- computer-based tutoring systems for training in specialized areas and distance education

8.3 Implications for the Industry

The amount of time between the introduction and extensive use of a new technology is much shorter than it was even ten years ago. Although AI and other technologies may seem exotic, they are in fact already being used in order to enhance existing products by providing new and better solutions for users. Therefore, if New Brunswick software companies are to survive, it is vital that they are provided with opportunities for early exposure to the tools, technologies, and environments outlined in the previous sections.

New Brunswick software companies are at an early stage of development, and require government assistance in the introduction and application of these technologies. The government should also provide support by developing a program to support R&D initiatives in the areas discussed in Section 8 of this report, thereby helping to ensure that state-of-the-art technologies and people trained in their use are available within the province.

Government should support the initial establishment and operation of a provincial computer network with connections to the existing NB/PEI University network and the Canadian CDnet presently being established to replace Netnorth (BITNET). Such a computer network could provide the software industry with both an information exchange and a means of access to software services and databases.

9.0 PLAN OF ACTION AND RECOMMENDATIONS

This section describes the recommendations identified by the Task Group. These recommendations are divided into two main categories: those we believe should be implemented immediately and those that should be implemented in the short-term. It should be noted that these recommendations have been assigned the following priorities:

A: High Priority
B: Medium Priority
C: Low Priority

9.1 Recommended for Immediate Implementation

9.1.1 Awareness Program: *A*

In conjunction with the New Brunswick software industry, the government should create an "Awareness Program," designed to make municipal, provincial, and federal departments and private industry aware of the long-term benefits to be realized by supporting New Brunswick software companies. The program would emphasize the importance of the New Brunswick software industry in terms of the overall industrial strategy as we head into the next decade. Provincial and municipal departments should be made aware of the direct and indirect economic and financial consequences of short-term purchasing decisions which do not favour provincial software companies.

9.1.2 New Brunswick Software Industry Association: *A*

Government should assist in the formation of a New Brunswick Software Industry Association. The basic purpose of such an association would be to serve as a unified organization that can act on behalf of its membership in matters that are important to the New Brunswick software industry. The association would serve the following functions:

- to make information about courses, seminars, and training workshops available to members

- to liaise with universities in order to recruit graduates for the members and in order to inform the universities as to what types of services and support will benefit the industry

- to act as a lobbying group for the industry

- to promote a positive and visible image for the industry

- to participate in the development and coordination of quality assurance programs

- to provide guidance for new software firms being established in New Brunswick

- to inform software developers about government procurement policies and ways in which to adapt to these policies

We recommend that the New Brunswick and federal governments support the establishment and functioning of such an association in the following ways:

- Government funding should be made available in order to cover both the costs of organizing and holding initial meetings and of preparing and distributing information about the proposed association to potential members.

- We believe that the association must eventually be financially self-sustaining if it is to be successful. We doubt, however, if this will happen immediately. Therefore, we recommend that, for a period of one year following the establishment of the association, the government subsidize its operations to a level of 50 percent.

- The government should assign a member of the Department of Commerce and Technology with the task of liaising with the association (possibly including attendance at the association meetings).

9.1.3 Publish and Maintain an Up-to-Date Industry Database and Directory: *B*

Because the software industry is dynamic and complex in nature, it has thus far eluded full and adequate description.

We believe that problems with the image of the New Brunswick software industry and with the limited availability of human resources can both be alleviated through the creation and distribution of an industry database and directory, containing a list of the firms that make up the software sector. In order to provide meaningful information about this sector, the industry database and directory must be updated frequently.

The New Brunswick Department of Commerce and Technology has already prepared an industry directory for 1989.

The Task Group recommends that:

- the industry directory be updated yearly, and the database be kept current.
- each edition of the directory be widely distributed so as to increase exposure for the industry. Since many people will not be aware of the existence of the directory, it is not sufficient to make the directory available only to those who request it.
- the directory be available in both printed and electronic format.
- the directory be distributed to:
  - potential clients of the industry.
  - students at Maritime universities and technical institutes in the final year of a Computer Science program. (NOTE: Students should receive copies of the directory in September or October each year, before they have committed to out-of-province employers.)

9.2. Short-Term Strategies

9.2.1 Develop a Program to Support R&D: *A*

The government should support the New Brunswick software industry by developing a program to support R&D initiatives in the areas discussed in Section 8 of this report (Strategic Technologies of Importance to New Brunswick), thereby helping to ensure that state-of-the-art technologies and people trained in their use are available within the province.

In addition, the provincial and federal governments should be encouraged to collaborate with private industry in software-oriented R&D projects.

9.2.2 Exploit Strategic Technologies: *A*

The provincial and federal governments should:

- support R&D initiatives in the areas outlined in Section 8 of this report by providing funding to those companies working with the identified strategic technologies.
- support the initial establishment and operation of a provincial computer network with connections to the existing NB/PEI University network and the Canadian CDnet currently being established.
- participate with private industry in the development and marketing of software.

9.2.3 Incentives for In-Province Training: *B*

The provincial government should provide incentives and/or facilities for holding courses and training seminars in New Brunswick. Such incentives would include:

- guaranteeing a minimum participation level for a course offered locally by the private sector
- promoting the use of both public sector resources (such as universities and community colleges) and the expertise offered by government employees in local training programs
- attempting to lure those out-of-province agencies offering training to New Brunswick by offering to cover any additional costs incurred by travelling to the province

9.2.4 Implement Financial Incentive Packages: *A*

In addition to the Public Stock Savings Plan, the New Brunswick government should select and implement one or more of the following mechanisms to encourage investment in local software companies:

- Registered Investment Business Plan
- Provincial Holding Company
- Participating Debentures

These options are all described more fully in Section 6.1.2 of this report.

9.2.5 Establish an Offset Program: *B*

In order to promote small New Brunswick software companies, the provincial government should establish an Offset Program which would require its out-of-province suppliers to spend a certain amount of money on New Brunswick developed software and/or services.

9.2.6 Enforce Existing Contracting-Out Policies: *A*

It is the understanding of the Task Group that the New Brunswick government's stated policy is to encourage private industry by contracting out software development wherever possible. The government should enforce this policy. Presently, the government's in-house Information System Group of Supply and Services is doing most of the development work.

9.2.7 Promote Marketing Assistance Programs: *A*

The New Brunswick and federal governments should encourage the use of those programs that are aimed at increasing the level of marketing expertise within the software industry.

9.2.8 Establish a Permanent Joint Organization: *A*

We recommend that a Permanent Joint Organization be formed with representation from the provincial government, the universities, and the software industry. The Organization's mandate would be to ensure, through dialogue, that the mutual interests of industry, government, and universities are served. The Organization could achieve this objective by:

- assisting in the improvement of the industry's image
- acting as bidirectional feedback and information conduit to the three participating sectors
- assisting in the development of a marketing infrastructure
- bringing to each sector an awareness of the human, financial, and intellectual resources available in the other two sectors
- disseminating to the software industry information regarding assistance programs such as IRAP, ACOA, RIBP, etc.
- participating generally in activities that would promote the growth and health of the New Brunswick software industry
- identifying new opportunities in the software industry

This proposed Permanent Joint Organization shares many of the goals of the Software Industry Association. However, the two organizations should exist independently because the former organization serves the broader interests of government and universities.

9.2.9 Support Computer Science Departments in Meeting Hardware and Software Requirements: *A*

The government should assist university Computer Science departments in attaining the required hardware and software by:

- providing a capital investment or subsidy in order to bring equipment in the Computer Science departments to a level comparable with that in other provinces.
- increasing yearly financial support to Computer Science programs so as to enable these programs to keep up with ever-changing hardware and software requirements.

9.2.10 Continue Business Support Programs: *B*

The Task Group strongly recommends that programs and services such as those described in Section 7.1 of this report be continued and augmented.

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GLOSSARY OF TERMS

Artificial Intelligence (AI): The branch of computer science that deals with using computers to simulate human thinking and to solve problems creatively.

Central Processing Unit (CPU): The part of the computer that handles and processes data.

Data Base: A collection of related information stored on a computer disk.

Distributed Computing: Describes an information system which is made more responsive to users by moving computer hardware and personnel physically closer to the people who use them.

Expert System: An "intelligent" computer program which uses the reasoning ability of experts in a particular domain in order to aid in the decision-making process.

Graphics Interface: A type of user interface in which the user performs operations by moving icons or pictures with a mouse (as on a Macintosh computer).

Inference Engine: The portion of an expert system which draws conclusions by performing logical operations on the knowledge base and the information input by the user.

Knowledge Base: The portion of an expert system which contains the expertise about a particular area.

Knowledge Engineering: The process of assessing problems, extracting and formalizing the rules the human expert uses to solve these problems, and building a knowledge base to contain this expertise.

Mainframe Computer: A large, "host" computer which typically supports 100 to 500 users at a time.

Microcomputer: A small computer used by only one person at a time.

Microprocessor: A single chip containing all the circuits necessary to perform the basic functions of a whole computer.

Minicomputer: A computer intermediate in size between a mainframe and a microcomputer. Typically supports 10 to 100 users at a time.

Natural Language: The branch of AI research that studies techniques which allow computer systems to accept input and produce output in a conventional language like English.

Network: An integrated system of computers, workstations, and communication channels that connects computers on the same premises (local-area network) or in different premises (wide-area network).

Neural Network: Analogous to brain activity, in which neural interconnections are made via a network, this term describes a program that "learns" by beginning with a simple network, looking for patterns, and building connections in that network in response to reinforcement from the environment.

Operating System: A program, such as DOS, UNIX, or OS/2, which controls a computer and makes it possible for users to enter and run their own programs.

Personal Computer (PC): A computer designed to be used by only one person at a time.

TCP/IP: Developed by the U.S. Department of Defense, this is one of several standard methods of connecting computers together.

User Interface: The portion of an expert system which controls the way the system communicates with the user -- for example, by means of menus or commands.

Workstation: An extremely powerful microcomputer, typically used for scientific and engineering calculations.